Performance Audit
Controlling Development's Impact on Storm Water Runoff

April 2001

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City Auditor's Office

City of Kansas City, Missouri

09-2001

April 25, 2001

Honorable Mayor and Members of the City Council:

This audit of the city's efforts to control storm water runoff resulting from new development was initiated by the city auditor pursuant to Article II, Section 13 of the city charter. Councilman Ed Ford asked the city auditor to prepare a memorandum reviewing the city's methodology for determining development's impact on storm water runoff and its process of evaluating runoff analyses submitted by developers. This request followed public testimony in the Planning, Zoning, and Economic Development Committee regarding increased storm water runoff resulting from new development. The city auditor determined the potential issues were too significant to be addressed in a memorandum and initiated this audit, focusing on the city's efforts to control runoff and on identifying ways that those efforts could be improved.

Storm water runoff occurs when the intensity of a rainfall event exceeds the rate at which water can be absorbed by the surface of the ground. Urbanization and new development increase the surface area covered by materials such as asphalt and concrete that cannot absorb as much rainfall as undeveloped land. As a result, development can increase both the volume of runoff and the speed or rate at which storm water travels downstream. The city's policies and regulations attempt to minimize storm water runoff caused by new development, but do not address runoff problems downstream of the development that existed prior to the development's construction. Other mechanisms are expected to address these problems. Public Works engineers review developer studies and plans for storm water control on the development site. Because developers are only required to control runoff generated by the project, previous runoff problems in the watershed area may not be completely remedied by any individual development's storm water control measures.

Public Works staff review the storm drainage studies submitted by developers that quantify the additional runoff the development will generate and the proposed method for controlling it. We found copies of the approved studies in every file and found evidence that the Public Works engineers rejected some storm water studies originally submitted, and approved the revised studies.

Developers are required to build detention facilities to collect the increased runoff resulting from the project when appropriate. These facilities may actually contribute to flooding downstream, if multiple detention facilities in one or more developments release collected storm water simultaneously. The city inspects these private facilities during construction but does not maintain or control them, once built. Poorly maintained or clogged detention facilities could contribute to further flooding downstream.

We recommend the city consider several changes that might improve control over storm water runoff. These include eliminating or further restricting developer's use of the "rational method" to estimate runoff, consider reducing the maximum allowable rate at which storm water can be released from private detention facilities, clarifying requirements on allowable runoff rates, and sometimes using regional public facilities, paid for by developers through the use of a fee in lieu of detention.

We sent the draft report to the director of Public Works on March 7, 2001 and to the director of Water Services on March 8, 2001. Their written responses are included as appendices. We appreciate the courtesy and cooperation extended to us during this project by staff in the Public Works, Water Services, City Planning and Development, and Codes Administration departments. We would also like to thank Dr. Jerry Richardson of the University of Missouri – Kansas City and Dr. Kathleen M. Trauth of the University of Missouri – Columbia for contributing their time and expertise to this audit. The audit team for this project was Anatoli Douditski, Robin K. Reed, and Gary White.

Mark Funkhouser
City Auditor

Performance Audit: Controlling Development's Impact on Storm Water Runoff

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List of Exhibits

Introduction

Objectives

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Councilman Ed Ford asked the city auditor to prepare a memorandum for the City Council that reviewed the city's methodology for determining development's impact on storm water runoff and its process of evaluating runoff analyses submitted by developers.

Following a preliminary investigation, the city auditor determined the potential issues were too significant to be adequately addressed in a council memorandum. As a result, the city auditor initiated this performance audit pursuant to Article II, Section 13 of the Charter of Kansas City, Missouri, which establishes the Office of the City Auditor and outlines the city auditor's primary duties.

A performance audit is an objective, systematic examination of evidence to independently assess the performance of a government organization, program, activity, or function in order to provide information to improve public accountability and facilitate decision-making.[1] This audit was designed to answer the following questions:

- What is the city's policy regarding proposed development's impact on storm water runoff?
- How does the city assess proposed development's impact on storm water runoff?
- How could the city's efforts be improved?

Scope and Methodology

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We conducted this audit in accordance with generally accepted government auditing standards, except for completion of an external quality control review of the City Auditor's Office within the last three years.[2] Our methods included:

[1] Comptroller General of the United States, *Government Auditing Standards* (Washington, DC: U.S. Government Printing Office, 1994), p. 14.

[2] The last review was in April 1995. An external review is scheduled for May 2001.

- Interviewing city staff in the Public Works, Codes Administration, City Planning and Development, Law, and Water Services departments.

- Reviewing the city charter, code of ordinances, and documents describing the city's storm water drainage system requirements.

- Reviewing project files at the Public Works' Engineering Division, Development Service Section.

- Researching information on storm water control methods, EPA requirements, and storm water control efforts in other cities.

- Consulting with Dr. Jerry Richardson, professor of hydrology at the University of Missouri - Kansas City, and Dr. Kathleen M. Trauth, professor of hydrology at the University of Missouri - Columbia regarding urban rainwater runoff modeling and the environmental aspects of hydrology**.**

This report focuses on the city's efforts to control the volume or quantity of storm water generated by area rainfall. It does not address issues concerning the quality of storm water passing through the city's storm water control facilities.

No information was omitted from this report because it was deemed privileged or confidential.

Background

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Storm water runoff occurs when the intensity of a rainfall event exceeds the rate at which water can be absorbed by the surface of the ground. It is that fraction of the rainfall that moves over the surface or through the soil toward ponds, lakes, streams, rivers, etc. Urbanization and new development increase the surface area covered by impervious materials such as asphalt and concrete that cannot absorb as much rainfall as undeveloped land.

Urbanization changes the natural hydrology of a watershed by increasing runoff. When an area is developed, natural drainage patterns are modified as runoff is channeled into road gutters, storm drains, and

paved channels. The results of these modifications are typically an increase in runoff volume and velocity.[3]

In order to protect the public and the environment against flooding caused by new development, Public Works requires that developers submit plans and reports describing how additional runoff will be controlled, usually through detention basins. Detention basins slow down the speed or rate at which storm water runoff travels from a drainage area, thereby reducing flooding and erosion downstream.

Overview of the Development Review Process

New development in Kansas City requires City Council approval. The development approval process can involve several departments. The developer usually begins the process by submitting a proposal to City Planning and Development. Depending on whether or not rezoning is required, the development is heard by either the Board of Zoning Adjustment or the City Plan Commission. From there, the proposal goes to the City Council then to the Planning, Zoning, and Economic Development Committee for testimony from the developer, city staff, and the public. Following the public hearings, the proposed development plan or case is sent to the city clerk to be scheduled for deliberation by the City Council.

Once approved by the City Council, the developer submits engineering construction plans to Public Works and building site plans to Codes Administration. If the proposed construction plans include water service extensions or improvements, those plans are submitted to Water Services. The materials submitted to Public Works include engineering construction plans and drainage studies reviewing the impact the proposed development will have on area runoff and proposed plans to control any increased runoff. Once Public Works approves the submitted materials, a final ordinance is introduced to the City Council. Following their approval, permits are issued and construction begins.

The Public Work's Development Services section reviews developers' storm water drainage studies and other engineering designs for proposed developments in residential and commercial subdivisions. Public Works engineers are expected to review each development plan within 10 business days. According to Development Services staff, the goal is to meet this standard 90 percent of the time. In 2000, the division

[3] Camp Dresser & McKee; Larry Walker Associates; Uribe and Associates; and Resource Planning Associates for the State of California Stormwater Quality Task Force, *Best Management Practice Handbook*, March 1993, pp. 1-3.

employed six review engineers and performed approximately 700 storm drainage study reviews.[4] (See Exhibit 1 on the next page for a flowchart of the city's development approval process.)

Legislative Authority

City Charter. Article I, Chapter 1, Section 18 of the charter, states that the city is to protect against floods by diverting or improving watercourses. Section 345 states the city is also responsible for the construction of items such as storm sewers, flood protection improvements, or flood protection devices for the safety of the citizens or the protection of property. Section 29 states the Public Works director is responsible for maintaining public buildings including bridges, streets, waterways, and levees not under the control of any other department.

Code of Ordinances. Chapter 63 of the Code of Ordinances establishes the city's requirements for storm water, erosion, and sediment control. Section 63-1 states the city will protect citizens from damage from storm water runoff and floods by designing, constructing, expanding, and maintaining storm water control facilities. Section 63-27 states the city will adopt and maintain design criteria for erosion and sediment control. The principles guiding the design criteria include:

- Fit the development to existing site conditions
- Minimize the extent and duration of exposure
- Protect areas to be disturbed from storm water runoff
- Stabilize disturbed areas
- Keep runoff velocities low
- Retain sediment on the site
- Inspect and maintain control measures
- Performance measures and outcomes

[4] This figure does not represent the number of individual projects, but rather the number of storm drainage studies submitted for review. Projects whose plans were initially rejected will have multiple reviews until the plan is considered acceptable.

Exhibit 1. Development Approval Process

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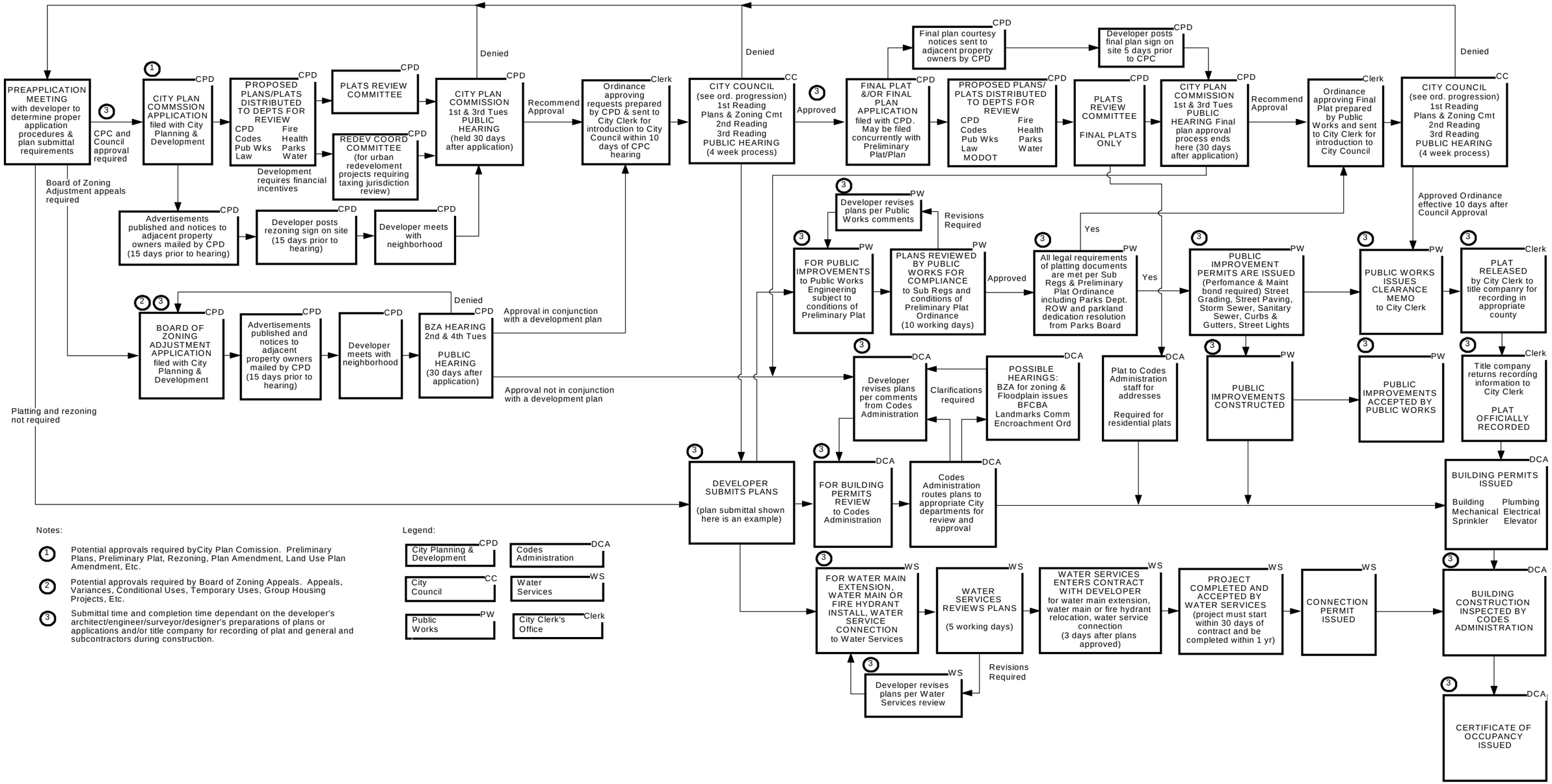

Notes:

1. Potential approvals required byCity Plan Comission. Preliminary Plans, Preliminary Plat, Rezoning, Plan Amendment, Land Use Plan Amendment, Etc.
2. Potential approvals required by Board of Zoning Appeals. Appeals, Variances, Conditional Uses, Temporary Uses, Group Housing Projects, Etc.
3. Submittal time and completion time dependant on the developer's architect/engineer/surveyor/designer's preparations of plans or applications and/or title company for recording of plat and general and subcontractors during construction.

Legend:

- CPD — City Planning & Development
- DCA — Codes Administration
- CC — City Council
- WS — Water Services
- PW — Public Works
- Clerk — City Clerk's Office

Source: Codes Administration.

Chapter 66 describes the city's requirements for subdivisions. Section 66-127 specifies that retention basins will be used to control runoff following development.

GLOSSARY

100-year event – a rainfall, runoff, or flood event having a one percent chance of occurring in a given year.

2-year event – a rainfall, runoff, or flood event having a fifty percent chance of occurring in any given year.

Detention facility, detention pond, retention basin – any structure, device, or combination thereof with a controlled discharge rate less than its inflow rate.

Drainage study – a report submitted to Public Works by a registered professional engineer that verifies, using adopted criteria, the adequacy of the proposed storm drainage system to serve the watershed and the proposed development.

Hydrology – the science that deals with the behavior of water in the atmosphere, on the surface of the earth, and underground.

Master Drainage Plans (Watershed Study) – a report which the location of all drainage facilities in a watershed area, including those that currently exist, those determined to be needed and those intended to be constructed in the future.

Rational Method – a method of calculating peak runoff rates based on rainfall intensity and a runoff coefficient based on land use.

Watershed - a region or area that drains to a particular watercourse or body of water.

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Findings and Recommendations

Summary

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City policies and regulations are designed to control increases in storm water runoff caused by new development, but do not address existing problems. As a result, existing flooding problems will not be remedied by a new development's proposed storm water control measures.

Developers are required to build detention basins, when appropriate, which collect the runoff and slow down the rate at which it travels downstream. Detention facilities must be constructed according to the city' guidelines that limit the volume of runoff the development can generate and limit the rate at which these facilities can release the storm water collected on the property. These detention facilities may actually contribute to flooding downstream if the runoff discharged by several such facilities is released simultaneously. In addition, Kansas City storm water detention facilities are constructed and maintained privately and are only inspected by the city during construction. As a result, city engineers have no specific knowledge about the condition of existing storm water control facilities. Public Works engineers review and approve detention facility designs and construction plans submitted by developers but do not consistently document their review process. We recommend consistent documentation of storm water plans review.

Research and interviews with hydrology experts identified a number of ways that the city could potentially improve its efforts to control runoff caused by new development. The most significant of these changes would involve using regional, publicly-owned detention facilities, in some cases, financed by payments made by the developer as an alternative to constructing their own private detention facilities. In addition, the city should consider eliminating or further restricting use of the "rational method" when estimating storm water runoff, consider reducing maximum allowable storm water release rates, and clarify the city's requirements when lower release rates are justified.

City Policies Only Address Storm Water Runoff Caused by Development

The city's storm water control policy is intended to minimize the impact of new development on existing area runoff. The code allows proposed development to increase area runoff to no more than the level of runoff normally expected for typical residential development. Public Works engineers review engineering studies and construction plans in an attempt to prevent proposed development from increasing runoff rates beyond pre-development levels. Because developers are only required to control runoff generated by their development, any existing runoff problems in the watershed area may not be remedied by an individual development's storm water control measures.

Additional Runoff from New Development Is Permitted

City code allows new subdivision developments to generate some increase in runoff however, for excessive runoff, the code suggests using retention basins where appropriate to control the rate at which runoff travels downstream. According to Section 66-127(b) of the Code of Ordinances:

> When the proposed development of a subdivision would increase the runoff of storm water onto adjoining properties, above that normally expected for residential development typical for the city, retention basins may be required on the site to control the rate of runoff, except as otherwise permitted by the city engineer on the basis of an individual subdivision design and approved on the preliminary plat.

Public Works requirements are partly based on industry standards. The American Public Works Association (APWA) set forth requirements for determining development's impact on area storm water runoff in a document entitled *Section 5600, Storm Drainage Systems and Facilities* (APWA 5600). Public Works adopted this document by Resolution 900780 in December 1990, along with a supplement prepared by the department that modifies some of the APWA 5600 requirements. The supplement was modified in April 1993.

The supplement modifies some of the definitions included in APWA 5600, allows some adjusting of the formula for estimating runoff, and expands on some of the requirements for certain components of storm water control facilities including inlets, easements, joints, lining

materials, and sewer system connections. Combined, these documents reflect the standards the engineer hired by the developer should follow when submitting development plans for the city's review and approval. The APWA 5600 requires that the design of storm water drainage systems be based on land use as zoned, actually developed, or based on an adopted future land use plan, whichever basis produces the greatest runoff.

Review Process Is Designed to Prevent Increases in Runoff Rates

In order to monitor runoff resulting from new development, the Code of Ordinances requires the developer's engineer to prepare a storm water drainage study for each proposed development. Public Work's Development Services Section reviews the submitted storm water drainage studies and construction plans. Public Works review engineers verify that proposed development plans will not increase storm water runoff rates above the existing or established levels and that the plans submitted by developers conform to engineering standards adopted by the city.

When the proposed development is expected to increase storm water runoff rates, Public Works requires that developers prepare and submit plans to control this increase using detention facilities located on the property. Developers also have the option of addressing the increase by improving the storm drainage system downstream of the development and ensuring the downstream systems are capable of handling the increased runoff. Developers rarely choose this option, however, due to the higher cost and the distance downstream they must make the improvements.

Existing Runoff Problems May Remain

The code requirements for new development only address increases in runoff caused by the development. Developers are not required to alleviate downstream flooding problems that existed prior to development. In addition, private detention facilities located on the developer's property only control the rate at which the runoff travels downstream. They do not reduce the increased volume of runoff discharged by the new development. If the pre-development runoff caused flooding before the new development was built, the problem will remain and may even increase due to the increased volume of runoff caused by the new development.

On-site detention facilities may not always be effective. On-site detention policy can result in a large number of small detention facilities. These small detention facilities may not be effective in preventing flooding in some cases. According to Dr. Jerry Richardson, an engineering professor of hydrology at the University of Missouri – Kansas City, such an approach focuses on trying to control or delay runoff but does not affect the volume of the storm water runoff. Discharges from individual detention ponds may combine at some point, and produce flooding for downstream properties.

The Northeastern Illinois Planning Commission reached the same conclusion in a 1994 report. The commission's *Model Stormwater Drainage and Detention Ordinance: A Guide For Local Officials* reports that:

> Many communities continue to rely on the philosophy that post-development peak discharges should not exceed pre-development peak discharges for a property. Although such an approach may be effective for protecting immediately adjacent properties, it likely will lead to increased downstream flood peaks because of the greater volume of stormwater discharge and because of the change in timing of these peaks.[5]

The city does not maintain private storm water control facilities. The Water Services Department maintains the public elements of the storm water control system. These elements include all sewers, appurtenances, catch basins, drains, drop inlets, field inlets, paved improved drainage channels, drainage easements along natural channels (rivers and creeks), flood pump stations along the Missouri River and the levee, the levee itself, an early flood warning system, and diversion tunnels. Maintenance involves keeping the system in good repair and periodic cleaning to keep the system free of debris, mud, and trash.

Public Works requirements state that owners are responsible for maintaining private on-site detention facilities. The city inspects these facilities during construction but does not routinely inspect the quality of maintenance of the private storm water control facilities, which include the smaller, private detention basins, private parking lot drains and pipes, and private sewer systems until the point where they tap into the public storm sewer. Should these facilities become inoperable or clogged with debris, they could contribute to flooding. In such cases, the

[5] Northeastern Illinois Planning Commission, *Model Stormwater Drainage and Detention Ordinance: A Guide For Local Officials*, (Chicago, Illinois, 1994), p. I-14.

code allows the city to declare the facility a nuisance and take action against the property owner.

Public Works Reviews Plans for New Development

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Our review of project files determined that Public Works staff does review and approve plans submitted by developers. Of the seven projects included in our review, three project files included evidence that the engineer rejected the storm water study originally submitted, and a subsequent development proposal was approved. However, our review also found that some approval documentation was missing or was recorded inconsistently. The Public Works Department should consider standardizing its documentation procedures.

City Requirements Describe Design Procedures

APWA 5600 and the city supplement provide uniform procedures for designing storm drainage systems under the rainfall and land characteristics typical of the Kansas City Metropolitan Area. The policies also describe technical and other characteristics for various drainage systems and prescribe the methodology for estimating existing storm water runoff and runoff generated by the proposed development and the runoff rate that should be controlled by the storm water drainage system.

In addition to APWA 5600 and city supplement, Public Works developed a checklist that assists developers by detailing the specific information that should be considered in their storm water drainage studies. The checklist also provides a list of sources of information developers can use in preparing storm drainage studies.

Public Works Engineers Review Storm Water Drainage Studies

As part of the approval process for proposed developments, engineers in Public Work's Development Services Section examine storm water drainage studies submitted by licensed engineers contracted by developers. The reviewers seek to ensure the storm water drainage study accurately describes the area surrounding and including the development, existing drainage conditions, and proposed drainage conditions following construction.

The study should also show how the storm water from a site will be collected and discharged into the city storm drainage system and/or open

channel systems. In addition, the study should analyze the city storm drainage system to ensure that it is adequate to carry additional runoff from the site. If it is not adequate, then the study must show how the developer will remedy the problem, primarily through the construction of on-site detention facilities.

To verify the information submitted by the developers' engineers, reviewers should compare the data in the storm water drainage study and plans with site plans, sewer maps, watershed studies, contour maps, aerial photos, topographical maps, and other sources. Reviewers should also consider the history and location of drainage problems in the area. The section's chief engineer states that he tries to assign the reviews of neighboring projects to the same review engineer and reports that the engineers also talk among themselves about the projects they review.

Project Files Document Review and Approval

Our review of the project files for seven development plans submitted to Public Works found evidence of staff review of the storm drainage studies and copies of studies that were ultimately approved. In addition to reviewing the files, we discussed the storm drainage studies and reviews with the engineer responsible and sought documentation of the reviews maintained in the KIVA system, the computerized database used to track development activities.

Some of the project files in our sample included copies of letters to developers whose storm drainage studies were not approved when first submitted. Out of a sample of seven files we reviewed, three files included review notes indicating the engineer rejected the storm water study originally submitted. In these instances, the developer's engineers are contacted, asked to correct the identified problems, and resubmit the correct study. Each time, the Public Works engineer must review the study to determine its adequacy and compliance with the city's requirements. This process continues until the Public Works engineer considers the study satisfactory and approves the study and plans.

Review Documentation Should Be Complete and Consistent

Public Works retains final approved copies of storm water drainage studies and plans submitted by developers. Our review of the files indicated limited documentation of the review process. We also found limited uniformity between engineers in how they document their reviews. While all the files included a copy of the final study and a development plan stamped "approved," the project files did not

consistently document the review engineer's process for evaluating the information contained in the studies submitted for each project.

Public Works staff now uses KIVA (the city's computerized software system that tracks development efforts) to track their reviews of storm water studies and plans. In addition, reviewers are required to file copies of their review comments in project files. Some of the project files sampled included the review comments. Sometimes, the comments were located in the KIVA system. Determining exactly where the documentation was located in some cases required seeking assistance from the engineer responsible for the review. This becomes a problem if the engineer is absent or leaves city employment. The director of Public Works should establish a uniform method of documenting storm drainage study reviews.

Storm Water Control Efforts Could Be Strengthened

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Although the city makes an effort to control storm water runoff resulting from new development, this effort could be strengthened by stricter requirements for estimating runoff, clarifying and possibly reducing the allowable release rate for detention facilities, and evaluating the feasibility of regional detention facilities.

Impose Stricter Requirements for Estimating Runoff

One method of estimating storm water runoff is the "rational method." Kansas City allows the rational method to be used to estimate runoff "when the total upstream area tributary to the point of consideration is less than 600 acres."[6] Our research of other jurisdictions found that some municipalities prohibit or restrict the use of the rational method to smaller areas.

The Village of Sleepy Hollow in Illinois restricts the use of the rational method to areas of up to five acres. The city of Branson, Missouri, restricts its use to areas of 100 acres or less. In Billings, Montana, use of the rational method is limited to areas of two acres or less.

The model ordinance published by the Northeastern Illinois Planning Commission (NIPC) similarly discourages use of the rational method,

[6] APWA 5600, Section 5602.6(A).

except in estimating runoff in the design of minor conveyance systems, because of "inherent inaccuracies" in its estimation of runoff.[7]

According to Dr. Richardson, the rational method is too crude for urban areas, particularly when other more sophisticated computer modeling methods exist. When allowed, 600 acres is the upper limit for estimating runoff using the rational method.

Estimates using the rational method are based on the assumption that the precipitation is uniformly distributed over the watershed area and that the rate of rainfall does not change during a storm. The professor considers these assumptions unrealistic.

For rural areas, problems arising from using the rational method to estimate runoff are negligible according to the professor. In urban areas, the unrealistic assumptions regarding the distribution and rate of precipitation, could have a significant impact on the usefulness of the results in accurately determining the runoff that will need to be contained.

Requiring developers to use more sophisticated techniques to estimate storm water runoff may result in higher quality storm water drainage studies, although the restriction may potentially increase developer costs.[8]

The director of Public Works should consider either eliminating use of the rational method as an option for developers completing storm water studies, or reduce the size of developments in which the method is an acceptable alternative.

Consider Reducing Maximum Allowable Runoff Release Rates

The city's requirement for constructing private retention basins includes guidance on the maximum release rate for the collected storm water runoff. Kansas City allows maximum release rates of 1.8 cubic feet per second per acre (c.f.s./acre). Other communities limit the release rates to lesser amounts. Sleepy Hollow, Illinois, does not allow the release rate to exceed 0.15 c.f.s./acre. In Billings, Montana, the maximum rate is 0.56 c.f.s. per 2 acres.

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[7] Northeastern Illinois Planning Commission, pp. I-20 and I-21.

[8] According to Dr. Richardson, calculating runoff using the rational method could take less than an hour, while more sophisticated methods could take as much as three hours to complete. If a developer uses an engineering firm to complete the storm water study, the additional time spent would be passed on to the developer.

According to the NIPC, allowable 100-year event peak discharge rates from detention facilities vary widely across the country. In the early 1970's, the Metropolitan Sanitary District of Greater Chicago (MWRD) and many other Illinois communities adopted the peak discharge from the 3-year event for undeveloped conditions (0.20 to 0.50 c.f.s./acre) as the maximum allowable 100-year event peak discharge rate from a property.

Based on historical flood release rates for different streams, other Illinois communities felt that MWRD's 3-year event release rate was not stringent enough to prevent increases in downstream flooding. Instead, they enacted ordinances calling for release rates of 0.15 c.f.s./acre or less.

NIPC's evaluation of detention effectiveness found that a 100-year release rate of 0.15 c.f.s./acre was effective in preventing an increase in downstream flood levels over pre-development conditions for a 30 square mile test watershed. For the test watershed NIPC studied, smaller release rates appeared to be unnecessarily restrictive. Higher release rates appeared to be not restrictive enough for watersheds much larger than 30 square miles.[9] The lower release rates required by other cities suggest Kansas City might consider reducing the maximum allowable release rate.

A reduction in the city's 1.8 c.f.s./acre maximum could result in higher developer costs associated with constructing private detention facilities capable of slowing the runoff to the lower release rates. A reduction in the maximum allowable release rate may offer better protection against storm water flooding. The Public Works director should consider reducing the maximum allowable release rate below 1.8 c.f.s./acre to a level that maximizes the effectiveness of the city's flood control efforts.

Clarify Requirements Concerning Lower Release Rates

The city's adopted APWA requirements provide some discretion in setting maximum allowable release rates. APWA Section 5606.4(B) states that:

> The maximum release rate from any development for the 100-year and more frequent storms shall not exceed 1.8 c.f.s. per tributary acre. When areas outside the development are also tributary, their inflow

[9] Northeastern Illinois Planning Commission, p. I-14.

> hydrograph(s) may be added to the above maximum release rate to determine the total maximum release rate. If the downstream conditions dictate a lower release rate, then the above release rates do not govern.

During her review of the city's requirements, Dr. Kathleen Trauth, an engineering professor of hydrology from the University of Missouri – Columbia, cites the above section of the APWA requirements and notes that the language in the section is not specific as to how much or under what conditions the release rate might have to be reduced below the 1.8 c.f.s./acre value.

The director of Public Works should consider clarifying the city's requirements to specify when the required runoff release rate will be less than 1.8 c.f.s./acre and either identify what the reduced release rate will be in those instances or describe a methodology for calculating the allowable rate.

Consider Regional Detention Facilities

On-site detention results in a large number of small, private detention facilities. The volume of the storm water collected by these small detention facilities can potentially contribute to flooding if runoff from the individual detention ponds are released simultaneously and combine at some point downstream. By collecting storm water runoff in regional detention facilities and increasing the capacity of the storm drainage system downstream of development, the city could better control storm water runoff in some cases. In addition, maintenance can be performed more efficiently for fewer, larger facilities and could provide more potential for using variable release rates to prevent downstream flooding. Watershed master plans could establish the appropriate location for regional detention facilities.

Regional detention facilities would provide protection against flooding for more than a single development by controlling storm water runoff for an area, rather than a single piece of property. When these facilities are constructed and maintained by a municipality, the city responsible for the facility has more control over where the detention facility is located and the rate at which the facility discharges storm water into the storm drainage system.

Fees in lieu of detention. One way of funding the construction of regional detention facilities is to charge developers a "fee in lieu of detention." Under this method, developers pay a fee instead of

constructing on-site detention basins. The local government uses the money derived from the fees to recover city funds used to acquire the sites and construct larger regional facilities.

Steps for Implementing a "Fee in Lieu of Detention" Program

1. Establish the administrative framework for collecting fees and determining where and how they will be spent.

2. Initiate watershed stormwater management studies to determine where regional facilities should be built and how stormwater will be safely conveyed to the facilities.

3. Appropriate funds for "opportunity regionalization," to allow the municipality to take advantage of regionalization opportunities which present themselves as part of the development process.

4. Determine how the fee amount will be computed and how fees will be guaranteed from properties (i.e., liens or special assessments).

5. Secure options on regional detention sites and proceed with construction when development indicates a need for action.

Source: Northeastern Illinois Planning Commission, *Model Stormwater Drainage and Detention Ordinance: A Guide for Local Officials*, (Chicago, Illinois, 1994), pp. I-10 and I-11.

Watershed studies improve storm water control. A key component of a fee in lieu of detention is knowledge of where regional detention facilities should be located. Master drainage plans (watershed studies) could help provide this information. Watershed studies identify the location of all drainage facilities in a watershed area, including those that currently exist, those determined to be needed, and those intended to be constructed in the future. The purpose of the report is to identify and alleviate present and future drainage and flooding problems in the city.

The City of Kansas City consists of 35 watershed areas. Studies describing each watershed area and any existing storm water problems must be routinely developed and updated. Water Services hires consultants to complete the watershed studies and reports that studies for eight of the 35 watersheds are completed or under contract. Water Services reportedly gives priority to undeveloped areas. The second priority is given to the areas that have had flooding problems because the

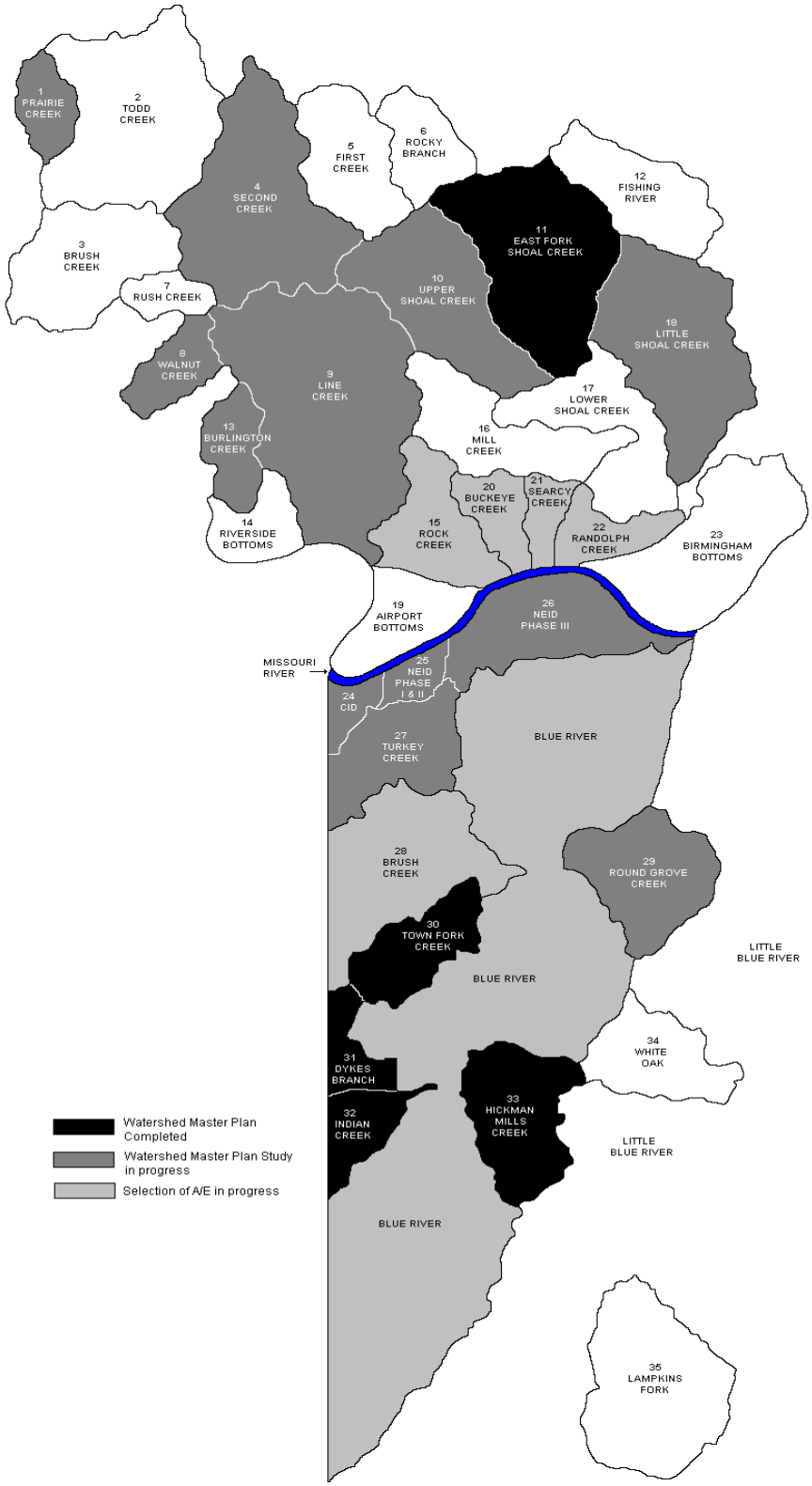
studies identify problem areas and describe recommended improvements. Once combined, the watershed studies will provide a single master plan covering the entire city.

Exhibit 2 on the following page is a map of the city's 35 watersheds identifying which locations have current completed watershed studies.

Once completed, the watershed studies might provide information necessary to identify the best locations for regional detention facilities. Regional detention facilities could not only address concerns regarding development's impact on storm water but also address existing flooding problems.

The directors of Public Works and Water Services should determine the feasibility of regional detention facilities. Effectively using regional detention facilities to control storm water runoff may require completion of the city's watershed studies to identify where the facilities should be located.

Exhibit 2. Kansas City, Missouri, Watershed Areas



Source: Water Services Department.

Recommendations

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1. The director of Public Works should establish a uniform method of documenting storm drainage study reviews.

2. The director of Public Works should consider eliminating the rational method as an allowable method developers may use to estimate storm water runoff or restrict use of the rational method to smaller sized developments.

3. The director of Public Works should clarify the city's requirements for releasing storm water, identifying instances when lower release rates are necessary and either stating the lower rate or including methodology for determining it in the city's supplement to APWA 5600. The director should also consider reducing the current maximum allowable release rate.

4. The directors of Public Works and Water Services should study and report on the feasibility of regional detention facilities financed wholly or in part by fees from area developers.

Appendix A

Public Works Director's Response

Interdepartmental Communication

DATE: April 12, 2001

TO: Mark Funkhouser, City Auditor

FROM: George E. Wolf Jr., ACM/Director of Public Works

SUBJECT: Revised Draft Follow-up Performance Audit on Stormwater Runoff

The Public Works Department has reviewed the audit and we agree with all the recommendations.

Although this audit focuses on the stormwater management associated with land development, it should be noted that this is only an incremental approach to stormwater management. To have an effective stormwater program requires these interim measures, completed watershed plans, policies and sufficient funding for implementation, and a process for maintaining and updating the master plans as incremental changes occur. We believe that implementation of the recommendations (particularly No. 4) will alleviate some of the stormwater concerns but will not solve all of the overall stormwater problems until stormwater is managed at the watershed level. We have long supported managing stormwater from a watershed perspective. We will also continue to support the efforts of the Water Service's Department Stormwater Utility in the implementation of stormwater watershed management practices.

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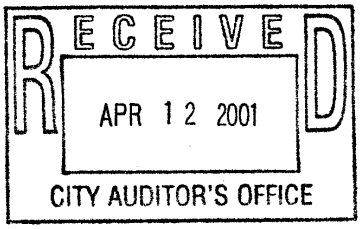

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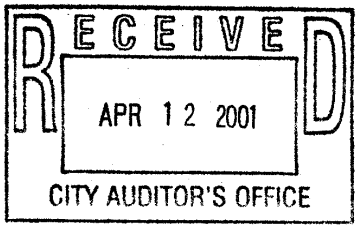
Appendix B

Water Services Director's Response

Inter-Departmental Communication



DATE: April 11, 2001

TO: Mark Funkhouser, City Auditor

FROM: Gurnie Gunter, Director of Water Services

SUBJECT: Controlling Development's Impact on Storm Water Runoff Audit Response

Recommendation 4. *The Director's of Public Works and Water Services should study and report on the feasibility of regional detention facilities financed wholly or in part by fees from area developers.*

Agree in part.
We have reviewed the draft *Performance Audit – Controlling Development's Impact on Stormwater Runoff*, dated April 2001, prepared by the City Auditor's Office. We agree in part with recommendation #4. As noted in the audit, the Water Services Department is in the process of conducting watershed master plans for each of the watersheds in the City, which will include the feasibility of using regional detention basins. However, these plans will recommend efficient and effective approaches for controlling stormwater on a regional basis, not necessarily regional detention. The Water Services Department believes that opting for regional detention facilities before completing the watershed plans is not in best interest of the City.

The Water Services Department plans to complete the watershed master plans for the 35 individual watersheds by FY 2004. After completion of the individual watershed master plans, the Water Services Department will develop a citywide stormwater management plan. The completion of the Citywide Watershed Master Plan requires reviewing and reprioritizing the results from the 35 water shed plans.

To effectively plan and implement for stormwater control on a regional basis, the ongoing watershed master plans need to be completed. Without the watershed master plans, the WSD cannot determine the type, number, location, size, or potential cost of the regional stormwater improvements. One of the techniques that will be considered to control storm water runoff is a regional detention facility[1] others include; micro detention; open lined and unlined channels; open or closed conduit; and piping and pumping stations. Consequently, reviewing the "feasibility of regional detention facilities…", before completing a watershed master plan is premature.

1 Both Smithville Lake and Longview Lake (as flood-control lakes) are, in essence regional detention facilities. Although not all regional detention facilities are the same size, it is worth noting that regional detention is one of the more area-intensive and expensive ways to manage stormwater runoff.

The potential cost for required stormwater improvements is high. For example, the Town Fork Creek Watershed study completed in 1997 identified $74 million in improvements to the existing stormwater system. Considering there are 35 watershed plans, the cost of these improvements for the entire City will be considerable.

The audit does not consider the impact of water quality requirements on stormwater management, which could be costly as the city moves towards a regional approach to storm water management. The U.S. Environmental Protection Agency and the Missouri Department of Resources are the primary legal authority for storm water issues and they have and continue to issue rules and regulations concerning storm water management. These regulations almost exclusively address stormwater quality issues, and they will have a significant effect on how Kansas City manages stormwater.

Upon completion of the Citywide Watershed Plan, WSD will start the second phase of storm water control efforts, financing and construction of the recommended storm water improvements. In order to finance the construction of the necessary improvements the Water Services Department will identify potential sources of construction funds; these options will include developer fees, state and federal grants, subsidized loans, and the city storm water fees. Upon completion of these efforts, WSD will report the findings and recommendations to the City Manager and Council for approval.

The Water Services Department appreciates the opportunity to comment on the report and associated recommendation. We also thank the City Auditor's Office for their efforts in this area.

Cc: Robert Collins, City Manager

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